

Big Rock Point Restoration Project
Final Status Survey Report
Part A - Excavated Surface and
Relocated Soil Surveys

DRAFT

Consumers Energy Company
April 2006

ATTACHMENT

D

Table of Contents

EXECUTIVE SUMMARY

1.0 Overview

- 1.1 Purpose and Scope
- 1.2 Description of Survey Areas
- 1.3 Site Release Criteria
 - 1.3.1 Application of Site Release Criteria
 - 1.3.2 Derived Concentration Guideline Levels
 - 1.3.3 Tritium in Soils
- 1.4 Discussion of Changes to the Final Status Survey Plan

2.0 Final Status Survey Methodology

- 2.1 Survey Units
 - 2.1.1 Classification
 - 2.1.2 Survey Unit Size
 - 2.1.3 Survey Unit Nomenclature
- 2.2 Instrumentation
 - 2.2.1 Calibration and Maintenance
 - 2.2.2 Instrument Response
 - 2.2.3 Minimum Detectable Concentration
- 2.3 Survey Methods
 - 2.3.1 Scan Measurements
 - 2.3.2 Volumetric Measurements
- 2.4 Survey Performance
 - 2.4.1 Procedures
 - 2.4.2 Training
 - 2.4.3 Sample Handling
 - 2.4.4 Data Investigation
 - 2.4.5 Data Management
 - 2.4.6 Quality Control Measurements
 - 2.4.7 Control of Vendor Services

3.0 Final Status Survey Results

- 3.1 Open Land Area Surface Surveys

- 3.1.1 Class 1 Survey Units
- 3.1.2 Class 2 Survey Units
- 3.1.3 Class 3 Survey Units
- 3.2 Supporting Surveys
 - 3.2.1 Excavated Surface Surveys
 - 3.2.2 Relocated Soil Surveys
- 3.3 Groundwater Surveys
- 3.4 Investigations
- 4.0 **Final Status Survey Data Assessment**
 - 4.1 Data Verification and Validation
 - 4.2 Summary of Changes from Initial Assumptions on Residual Radioactivity
 - 4.3 Release Criteria Verification
- 5.0 **Final Status Survey Conclusion Results**
- 6.0 **References**

Appendices

- Appendix A – Summary of Survey Units**
- Appendix B – Final Survey Preparation Process**
- Appendix C – Final Survey Package Release Records**
 - Appendix C-1 Class 1 Surveys
 - Appendix C-2 Class 2 Surveys
 - Appendix C-3 Class 3 Surveys
 - Appendix C-4 Excavated Surface Surveys
 - Appendix C-5 Summary of Relocated Soil Surveys

List of Tables

List of Figures

EXECUTIVE SUMMARY

Consumers Energy Company has decommissioned Big Rock Point Nuclear Plant to a Greenfield condition as defined in the approved Big Rock Point License Termination Plan (LTP) [Reference 1]. The final Greenfield condition of the site involved removal of all site buildings, foundations, buried piping, utilities and asphalt surfaces inside the Industrial Area. Office and storage buildings and underground utilities (conduit, storm drains, domestic piping, etc) outside the Industrial Area were also removed. Since no building structures supporting the former operating facility remain on site, final status surveys of the site consist of open land areas at final grade and also supporting surveys of excavated surfaces, relocated excavated soils.

Big Rock Point Final Status Survey Report – Part A contains the results for surveys of excavated surfaces and relocated excavated soils conducted prior to 2006 at the site of the former Big Rock Point Nuclear Plant. All final status surveys, as defined in the LTP, are scheduled for completion in November 2006 after all demolition activities are complete. The Final Status Survey Report consists of three parts as outlined below to facilitate timely review of survey data prior to unrestricted release of site land areas encompassing impacted and non-impacted land areas associated with the former nuclear plant site.

The table below provides a summary of submittals of Final Status Survey Report survey data.

<u>Submittal</u>	<u>Description</u>	<u>Target Date</u>
Part A	Class 1 Excavated Surface and Relocated Soil Surveys (conducted 2003 – 2005)	April 2006
Part B	Class 3 Outlying Land Area Surveys	July 2006
Part C	Class 1, 2, 3 Land Areas, Excavated Surfaces and Relocated Soils	December 2006

All Final Status Surveys and supporting surveys were performed in accordance with the final status survey plan described in Chapter 5 of the LTP. The site land areas were divided into 34 final surface survey units, encompassing approximately 475 acres (1.92 square km) of land area, and classified according to their potential for containing residual radioactivity. Nineteen final surface survey units are classified as Class 1, eight final surface survey units as Class 2, and seven final surface areas as Class 3. Additionally, supporting survey data for excavated surfaces and relocated soils are also presented in this report.

Survey data were collected from each survey unit according to data collection patterns and frequencies established for each classification. The final status survey data demonstrate that each survey unit meets the radiological criteria supporting release for unrestricted use as specified in 10 CFR 20.1402. Based on the results of the final status and supporting surveys, Consumers Energy Company concludes that all land areas contained in this report meet requirements for unrestricted use and is suitable for release from the 10 CFR 50 license.

1.0 OVERVIEW

1.1. Purpose and Scope

This report provides information required by 10 CFR 50.82(a)(11), which demonstrates that Big Rock Point land areas meet the radiological criteria for unrestricted use specified in 10 CFR 20.1402. The final Greenfield condition of the site includes demolition and offsite disposal of all site buildings, foundations, subsurface piping components and utilities that supported the former operating facility.

This report also documents that Final Status Surveys were performed in accordance with the final status survey process described in the Big Rock Point License Termination Plan (LTP). Final Status Surveys were conducted on open land areas at final grade elevation. Supporting surveys include release records for surveys of excavated surfaces upon removal of building foundation materials and surveys of relocated soil designated for backfill upon completion of demolition activities.

1.2. Description of Survey Areas

The survey units associated with the BRR Final Status Survey Report are shown in Figure 1-1. Appendix A contains a description of individual survey units and a summary of changes, if applicable, made to survey units since site characterization; all revisions to survey units were made in accordance with LTP Section 5.2.2.4.

Final site survey data are presented in three parts as outlined below:

- | | |
|--------|--|
| Part A | Class 1 Excavated Surface and Relocated Soil Surveys (conducted 2003 – 2005) |
| Part B | Class 3 Outlying Land Area Surveys |
| Part C | Remaining Class 1, 2, 3 Land Areas, Excavated Surfaces and Relocated Soils |

Survey data presented for Part A of this report include excavated surfaces where the Turbine Building, Screenhouse and Solid Radwaste Vault foundations were located, the dewatered Discharge Canal, and relocated soil designated as suitable for future onsite backfill material. All excavated surface surveys were designed and conducted to meet the requirements of a Class 1 survey unit. Part B surveys for are comprised of outlying Class 3 survey units where isolation controls were determined sufficient to allow FSS to be conducted while decommissioning activities were still in progress. Surveys for Part C include all remaining FSS and supporting surveys that could not be completed until all or the majority of decommissioning activities were complete.

Excavated surfaces where building foundations were formerly located were prepared for survey by a series of planned decommissioning activities. Planned decommissioning activities include historical site assessment, radiological characterization, dismantlement and demolition, remediation and finally readiness

surveys prior to turnover for final status and supporting survey. Appendix B provides a general discussion of decommissioning activity progression.

Relocated soils consist of soil removed for building foundation and subsurface component demolition/removal activities. This soil was evaluated (characterized) and, if suitable, relocated to a designated area for storage and final status evaluation. All relocated soil surveys were conservatively designed and executed to the requirements specified for Class 1 areas.

Appendix C provides completed release records for FSS and supporting surveys summarized in this report. Information included in completed release records includes FSS design, data verification and validation, data assessment, and conclusion for each survey unit.

1.3. Site Release Criteria

The site release criteria applied to each final status survey unit corresponds to the radiological criteria for unrestricted use provided in 10 CFR 1402 and as approved in the BRP LTP. These criteria are:

1. Dose Criterion: The residual radioactivity that is distinguishable from background radiation results in a Total Effective Dose Equivalent (TEDE) to an average member of the critical group that does not exceed 25 mrem/yr, including that from groundwater sources of drinking water and
2. ALARA Criterion: The residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA).

1.3.1. Application of the Site Release Criteria

Levels of residual radioactivity that correspond to the allowable radiation dose and ALARA levels of the site release criteria were derived by analysis of various scenarios and pathways (e.g., direct radiation, inhalation, ingestion) through which exposures could occur. These derived levels, referred to as Derived Concentration Guideline Levels (DCGLs), form the basis for the following four conditions which, when met, satisfy the site release criteria:

1. The average residual radioactivity is equal to or below the DCGL;
2. Individual measurements, representing small areas of residual radioactivity which exceed the DCGL, do not exceed the elevated measurement comparison DCGL;
3. Where one or more individual static measurements exceed the DCGL, the average residual radioactivity passes the statistical Sign Test; and
4. Remediation is performed where it is ALARA to reduce the levels of residual radioactivity below the concentrations necessary to meet the DCGLs.

The manner in which these conditions were met is described in Section 2.0.

1.3.2. Derived Concentration Guideline Levels

The residual radioactivity concentration levels for surface and subsurface soils in the Industrial Area (Class 1 and Class 2 areas) and outlying Class 3 areas were compared to the site-specific DCGLs developed specifically for volumetric residual radioactivity as provided in the LTP using the unity rule. These site-specific DCGLs are provided in the following table:

Table 1-1. Site-Specific Industrial Area DCGLs

Radionuclide	25 mrem/yr Limit Open Land Areas (Surface and Subsurface Soils, pCi/g)
H-3	3.27 E+02
Mn-54	1.37 E+01
Fe-55	3.58 E+05
Co-60	3.21 E+00
Sr-90	2.48 E+00
Cs-137	1.32 E+01
Eu-152	7.35 E+00
Eu-154*	6.78 E+00
Eu-155*	2.87 E+02

*Europium is included to address potential contamination of soil from concrete demolition activities.

DCGLs for Cs-137 and Co-60 presented above were modified to account for the presence of hard-to-detect (HTD) nuclides, Sr-90 and Fe-55, respectively, using surrogate ratios developed from characterization. The modified Cs-137 DCGL of 11.93 pCi/g accounts for the HTD nuclides.

1.3.3. Tritium in Soils

Tritium analyses on 10% of the final status survey samples for survey areas impacted by the tritium plume were required (LTP Section 5.4.2.4). These areas included the Turbine Building, Liquid Radwaste Vault and Containment foundations. Investigation was required for any sample that exceeded 10% of the tritium DCGL (32.7 pCi/g) and complete resampling, with analysis of all soil samples for tritium was required if investigation showed that 50% of the tritium DCGL (164 pCi/g) was exceeded. No soil samples exceeded these investigation levels.

All soil tritium samples were protected from moisture loss in the interval between sampling and analysis and analyzed by an accredited laboratory (LTP Section 5.2.1.3).

1.4. Discussion of Changes to the Final Status Survey Plan

No changes to the Final Status Survey Plan as approved in Chapter 5 of the LTP were identified during conduct of supporting surveys or final status surveys at the Big Rock Point site. Changes to initial survey area classification were anticipated and are summarized in Appendix A.

2.0 FINAL STATUS SURVEY METHODOLOGY

Final Status Surveys were designed and performed as described in the LTP, Chapter 5 and in accordance with NUREG-1575. The Data Quality Objective (DQO) process was used to ensure that each final status survey was of sufficient quality to support future unrestricted release of the site property. Land areas were divided into survey units of proper size, which were categorized and classified according to the type and potential for residual radioactivity. Characterization and remediation data were used to design surveys and these survey designs were reviewed then translated into field instructions for data collection. Instrumentation and survey methods, appropriate to the type of radiation being measured, were used to collect scan, volumetric and supplemental measurements. The measurements were collected in accordance with site procedures and quality controls instituted to ensure accurate results.

2.1. Survey Units

Land areas were divided into 34 survey units based on the physical characteristics, the potential for elevated residual radioactivity, and the size of the area with similar potential for residual radioactivity.

2.1.1. Classification

Survey units were categorized as Class 1, Class 2, or Class 3 based on the potential for residual radioactivity in accordance with the methodology in NUREG-1575 and as described in Chapter 5 of the BRP LTP. Areas with residual radioactivity that had the potential to exceed the DCGLs prior to remediation were divided into Class 1 survey units. Areas with residual radioactivity that were not expected to exceed the DCGL prior to remediation were divided into Class 2 survey units. Areas with a low probability of containing residual radioactivity detectable above background levels were divided into Class 3 survey units. Several survey areas were reclassified from their initial classification in the LTP to a more restrictive (more conservative) classification due to decommissioning activities that affected these areas after initial classification.

2.1.2. Survey Unit Size

Survey units were sized in accordance with NUREG-1575 guidance and were designed to have relatively simple shapes unless an unusual shape was appropriate for the operational history of the area or as a result of decommissioning activities, i.e., excavation footprints. Class 1 surface areas and excavation surfaces were sized to maximum 2000 m². The majority of relocated soil surveys were a maximum of 2000 m²; however, a small number of these surveys exceeded recommended 2000 m² size. A technical justification for size

deviations of Class 1 surveys was provided as part of the completed survey package (see Appendix C). Class 2 survey areas were all less than 10,000 m² in size. While a maximum size guideline for Class 3 survey units does not exist, the largest Class 3 survey unit at BRP was 256,000 m².

2.1.3. Survey Unit Nomenclature and Location

The nomenclature for identification of final status and supporting surveys is described by the following:

NNT_TC Example: 09C_Q1

Where:

- NN - Unique alphanumeric survey unit identifier
- T_T - Survey type
 - C_Q - Final survey of excavated (quarry) surface
 - C_x - Final survey relocated soil
 - C - Final Status Survey of open land area
- i - Survey iteration (1, 2, 3 ...)
- C - Survey unit initial classification (1, 2 or 3)

Survey units were identified by reference to an established site grid plan. The southwest corner of each area represents the identifying origin of each survey unit. The site grid plan coordinates with reproducible field locations facilitates survey management and design, ensures accurate location of survey measurements, and permits the replication of survey areas for remediation and measurement verification as necessary. Class 3 survey unit origin and sample points were also referenced to longitude and latitude.

2.2. Instrumentation

Radiation detection and measurement instrumentation for the FSS was selected to provide both reliable operation and adequate sensitivity to detect the radionuclides identified at the site at levels sufficiently below the DCGLs. Site history and characterization efforts identified Cs-137 and Co-60 as the predominant radionuclides present in BRP site soils. Soil sampling and analysis have demonstrated that direct measurements of Cs-137 and Co-60 can be used as surrogates for estimating levels of other contaminants that may be present in BRP soils. Detector selection was based on detection sensitivity, operating characteristics and expected performance in the field. Portable instruments, laboratory instruments and bulk assay equipment were used to perform FSS measurements. Final Status Survey instrumentation characteristics are provided in Table 2-1.

2.2.1. Calibration and Maintenance

Instrumentation used for the FSSs is calibrated and maintained in accordance with site procedures. Instruments and detectors were calibrated for the radiation types and energies of radionuclides known to be present at the site. Radioactive sources used for calibration are traceable to the National Institute of Standards and Technology (NIST) and have been obtained in standard geometries to match the type of samples being counted.

2.2.2. Instrument Response

Instrumentation response checks for field instruments are conducted daily before and after each use to ensure proper instrument response and operation. Laboratory instruments are checked daily in accordance with instrument procedures. Source checks use source energies consistent with the nuclides encountered at the BRP site. If an instrument failed response check, it is appropriately identified and withheld from use until the problem was corrected in accordance with applicable procedures.

2.2.3. Minimum Detectable Concentration

A minimum detectable concentration (MDC) was determined for each type of instrument and measurement method used for survey data collection. Instruments used for surface scanning were capable of detecting radioactive material at levels below the DCGL.

Laboratory gamma spectroscopy instruments used for soil volumetric sample analyses are capable of residual radioactivity detection at values less than 5% of the DCGL_w using a one-liter Marinelli geometry. The laboratory counting system has software controlled count times which are set to meet a maximum MDC of 0.13 pCi/g for Co-60 and 0.15 pCi/g for Cs-137 in soils.

Gamma spectroscopy using the bulk assay instrumentation was utilized where appropriate for analyzing soil-like materials (gravel, small stone, etc.) in large containers prior to use as potential backfill material. The methodology for this equipment is described in LTP Section 5.4.3.

Table 2-1. FSS Instrumentation Characteristics

Instrument and Detector	Measurement Type	Instrument Efficiency	MDA/MDC
2" x 2" NaI	Gamma*	1200 cpm/mR/hr (Cs-137)	Class 1, 2 & 3 < DCGL**
Canberra Genie	Laboratory Gamma	44.1%	< 5% of < DCGL
Bulk Assay	Gamma	20.0 %	< 15% of < DCGL

* Scan for gamma emitting nuclides using the Ludlum 2350-1 rate meter or equivalent.

** MDC values for varying background values are provided in LTP - Appendix 2-D.

2.3. Survey Methods

Survey methods, as described in the following sections, were applied to collect scan and volumetric measurements of residual radioactivity of land areas. The techniques for performing survey measurements and collecting samples are specified in approved site procedures. Final status survey measurements include field scans and gamma spectroscopy analysis of soil samples.

2.3.1. Scan Measurements

Scan measurements of open land areas were performed to identify potentially elevated areas of residual radioactivity that required further investigation. Sodium iodide detectors were used for scanning open land areas at the BRP site.

Scan measurements of Class 1 survey units were performed over 100% of the surface/land area. Scan measurements of Class 2 survey units were performed over 10 to 100% of the surface/land area. For Class 3 survey units, scan measurements were performed for 1% to 10% of the surface/land area. In Class 2 and Class 3 survey units, those areas with the highest potential for elevated residual radioactivity, based on historical judgment, were selected for scanning. The extent of scan coverage for each survey unit was determined based class requirement for the survey unit, historical knowledge and physical limitations of the survey unit.

2.3.2. Soil Sample Measurements

Measurement locations of soil samples were specified in the survey design process using a random-start systematic spacing methodology for Class 1 and Class 2 survey units in accordance with site procedures and NUREG-1575. For Class 3 survey units, measurement locations were selected using a random section process. Scale drawings or maps are prepared for each survey unit depicting all data collection locations measured from the survey unit origin (Class 1 and 2 areas) or located by GPS (Class 3 areas).

Soil sample size was sufficient to fill a one-liter marinelli container, nominally 1600 grams. Surface samples were collected from the top 15 cm of soil. Sample preparation included removing extraneous material, homogenizing, and drying the soil for gamma isotopic analysis. Separate containers were used for each sample and each container is tracked through the analysis process using a chain-of-custody record. Laboratory gamma spectroscopy was used to analyze collected soil samples. Samples were split when required by the applicable QC procedures.

Tritium analyses on 10% of the final status survey samples for all survey areas impacted by the tritium plume were required (LTP Section 5.4.2.4). Off-site laboratory facilities were utilized for tritium or QC measurements as specified in applicable survey design and associated site procedures. Analytical methods for offsite laboratory facilities were established to ensure minimum detection levels of 10% to 50% of the DCGL value (LTP Section 5.4.1).

2.4. Survey Performance

This section describes procedures and processes applicable to final survey design, data collection, review, and record keeping requirements for final status surveys.

2.4.1. Procedures

Final survey activities were implemented and controlled using approved site procedures. A list of applicable procedures is provided in the following table.

Table 2-2. Procedures Applicable to Final Status Survey Activities

Procedure Number	Title
D5.1	Radiation Protection and Environmental Services Policy and Program Description
D5.3	Big Rock Point Radiological Environmental Program
D5.19	Radiation Detection Instrumentation Calibration Facility and Source Control
D5.26	Final Status Survey Program
RM-76	Final Status Survey Design
RM-77	Final Status Survey Implementation
RM-78	Final Status Survey Assessment
RM-79	Final Status Survey Quality Control
RM-72	Sample Chain of Custody
RIP-59	Scan Measurements
RIP-60	Calibration and Operation of the Canberra Genie 2000 (In-Situ Gamma Spectroscopy)
RM-72	Sample Chain of Custody
CIP-46	Operation of Canberra "Genie"
CIP-50	Calibration, Functional Check and Use of Acculab V-4kg Balance
Volume 25	BRP Offsite Dose Calculation Manual
Volume 34	Quality Program Description for Nuclear Power Plants (Part 1) – Big Rock Point (and associated procedures)

2.4.2. Training

Final survey data collection and technical support staff were trained and qualified in the procedures performed under each respective job responsibility. Additional training was provided if any of the above procedures changed significantly. Personnel performing final status survey measurements were trained and qualified in procedures governing the conduct of the FSS, operation of field and laboratory instrumentation used in the FSS, and collection of final status survey measurements and samples. Qualification was obtained upon satisfactory demonstration of proficiency in implementation of procedural requirements. The extent of training and qualification was commensurate with the education, experience and proficiency of the individual and the scope, complexity and nature of the activity performed by that individual. Records of training and qualification are maintained in accordance with approved site procedures.

2.4.3. Sample Handling

A chain-of-custody record accompanied each volumetric sample from the point of collection through obtaining the final results to ensure the validity of the sample data. Sample tracking records were controlled and maintained in accordance with procedure RM-72, Sample Chain of Custody.

2.4.4. Data Investigation

Scan measurements were used to identify areas that may have contained elevated volumetric residual radioactivity. Locations identified by scan measurements as exceeding the action level of 1818 cpm were marked for investigation. Scan measurements were performed over 100 percent of the area being investigated to identify the lateral extent of potential residual radioactivity. Soil samples were then collected at these locations to further define the vertical extent of activity. Analysis of these soils samples was reviewed to determine whether the residual radioactivity exceeded the DCGL. Depending on the results of the investigation, the identified area(s) within the survey unit were remediated and resurveyed in accordance with LTP Section 5.3.6.2. Documentation of all investigation activities and corresponding results and evaluations are included in the appropriate survey package release record.

2.4.5. Data Management

Final survey measurements were performed only after verification that isolation measures to prevent recontamination were effective and that the survey unit was in its final configuration. Measurement results of statistical samples and scan data for final status and supporting surveys were included in the data set for each survey unit to determine compliance with the criteria for unrestricted release. Volumetric measurements were recorded and compared with the DCGLs. Measurement records include, at a minimum, the surveyor's name, the location of the measurement, the instrument used, measurement results, the date and time of the measurement, any surveyor comments, and records of applicable reviews. All data records are maintained in accordance with site procedures and are stored as a quality record in the final survey package release record.

2.4.6. Quality Control Measurements

Procedures governing final survey design and implementation have built-in QC checks for the survey process, instrumentation, field, and laboratory measurements. A minimum of 5% of final survey soil, water, and sediment samples were evaluated through the QC program. Quality Control measurements consisted of one or more of the following: in-house recounts, split samples, third party analysis, and/or statistical comparisons. Acceptance criterion was based on NRC Inspection Procedure 84750. Unacceptable QC comparisons received a documented investigation and reanalysis, resurvey, or resampling, as necessary.

2.4.7. Control of Vendor Services

Vendor laboratory services were utilized for analysis of QC measurement and tritium analyses. These services were secured in accordance with purchasing requirements for quality related services, to ensure the same level of quality as onsite analyses.

3.0 Survey Results

The survey unit package release record contains the number of measurements taken, a survey map, sample concentrations, statistical evaluations, including power curves, where applicable, and judgmental and miscellaneous data sets for each final status or supporting survey conducted. Each survey package also contains a summary of anomalous data if applicable. Tables 3-1 to 3-5 in this section also present a summary of these parameters.

3.1. Open Land Area Surface Surveys

3.1.1. Class 1 Survey Units

Class 1 Final Status Survey results for open land areas will be presented in Part C of the Final Status Survey Report. Table 3-1 provides a summary of Class 1 surface survey units.

Appendix C-1 contains all final status survey release records for Class 1 survey units.

3.1.2. Class 2 Survey Units

Class 2 Final Status Survey results for open land areas will be presented in Part C of the Final Status Survey Report. Table 3-2 provides a summary of Class 2 surface survey units.

Appendix C-2 contains all final status survey release records for Class 2 survey units.

3.1.3. Class 3 Survey Units

Class 3 Final Status Survey results will be presented in Parts B and C of the Final Status Survey Report. Table 3-3 provides a summary of Class 3 surface survey units.

Appendix C-3 contains all final status survey release records for Class 3 survey units.

3.2. Surveys Supporting Final Evaluation

3.2.1. Excavated Surface Surveys

Surveys of excavated surface areas were completed to demonstrate that all structural materials of plant origin were removed and that the exposed surface area met the criteria for unrestricted release prior to backfill. All excavated surface survey designs met the requirements of Class 1 area survey as specified in NUREG-1575 and was also performed following the guidance in Appendix E, Section 11.1 of NUREG-1727.

Surface excavated areas include former locations of Screenhouse foundation, Turbine Building foundation, Containment foundation, Gaseous Effluent Stack foundation, Liquid Radwaste Vault and Solid Radwaste Vaults, and Discharge Canal. Excavated surface survey units were established based on physical location, i.e., excavation footprint of removed foundations/structures, and Class 1 survey size limitations.

Table 3-4 provides a summary of excavated surface surveys. Appendix C-4 contains completed survey package release records for excavated surface surveys.

3.2.2. Relocated Soils

Soil removed to support removal of building foundations or subsurface components was relocated to a designated area for final evaluation prior to use as onsite backfill material. Prior to relocation, soils were evaluated (characterized) to determine suitability for transport to the area dedicated for excavated soils. Controls were instituted to prevent mixing of soils from different survey areas prior to evaluation. Once relocated these soils were graded to a maximum depth of one meter.

The primary method for evaluation of relocated soils originating from Class 1 and Class 2 areas followed the guidance provided in NUREG-1575 for final status survey of Class 1 areas. Relocated soil surveys met the design criteria for Class 1 area. Volumetric samples for laboratory analysis were homogenized over the total 1 meter depth of soil. Soils satisfying the criterion for unrestricted release were stockpiled for use as onsite backfill material.

Alternatively gamma spectroscopy using the large container assay system was also utilized for evaluation of small amounts of relocated soils (LTP Section 5.4.2.4).

Table 3-5 provides compilation of relocated, excavated soil surveys and Appendix C-5 contains a summary of completed survey data for relocated soils.

3.2.3. Tritium in Soils

There were no samples in any survey unit that exceeded 10% of the tritium DCGL.

3.3. Groundwater Surveys

Groundwater sampling and monitoring was performed during excavation of building foundations and subsurface structures and during final site survey of corresponding survey areas, as necessary. Groundwater sampling consisted of gamma spectroscopy analysis and tritium analysis; tritium was the only radionuclide identified in site groundwater. Groundwater and surface water control measures were instituted during demolition activities to minimize or eliminate the impact of water movement.

Existing monitoring wells within the tritium plume (wells MW-5 and MW-6 and piezometric wells PZ-3MA, PZ-3MB, PZ-3D and PZ-5S) were sampled periodically throughout the decommissioning project.

Groundwater survey results will be presented in Part C of the Final Status Survey Report. Table 3-6 contains all groundwater monitoring data for the site monitoring wells from 1999 - 2006. All groundwater monitoring well sample data were below the drinking water MCL for tritium of 20,000 pCi/L. No upward trends in this data were indicated ensuring that the hydrogeologic evaluation and stated conclusions in the LTP are valid (LTP Section 4.2.2.2). Figure 3-1 provides a graphical representation of groundwater monitoring tritium data for well locations with detectable tritium values. Since no groundwater contamination exists above the tritium MCL, monitoring wells have been abandoned in accordance with State of Michigan criteria (LTP Section 8.6.2).

3.4. Survey Unit Investigations

The results of the data investigations are summarized in Table 3-7. The details of the investigations are included in survey unit package release records (see Appendix C). Depending on the results of the investigation, the identified areas within the survey unit were remediated, and resurveyed in accordance with LTP Section 5.3.6.2.

Table 3-1. Class 1 Land Area Final Status Survey Results Summary – to be completed in Part C

Survey ID	Description	Survey Area (m ²)	Scan Coverage %	Soil Sample Measurements (pCi/g)							Weighted Sum Mean
				Number of Samples	Max	Co-60 Mean	Std Dev	Max	Cs-137 Mean	Std Dev	
01C ₁ 1	Southwest restricted area										
02C ₁ 1	West side of restricted area										
03C ₁ 1	Northwest restricted area										
04C ₁ 1	North restricted area										
05C ₁ 1	West central restricted area										
06C ₁ 1	South restricted area										
07C ₁ 1	Southeast restricted area										
08C ₁ 1	East central restricted area										
09C ₁ 1	Northeast restricted area										
10C ₁ 1	East restricted area										
11C ₁ 1	Solid radwaste storage area										
15(2R)C ₁ 1	West beach remediated during paint chip cleanup										
20C ₁ 1	New solid radwaste staging area										
22AC ₁ 1	Soil verification area A										
22BC ₁ 1	Soil verification area B										
22CC ₁ 1	Soil verification area C										
22DC ₁ 1	Soil verification area D										
22EC ₁ 1	Soil verification area E										
DCC ₁ 1	Discharge Canal final surface										

Table 3-2. Class 2 Land Area Final Status Survey Results Summary – to be completed in Part C

Survey ID	Description	Survey Area (m ²)	Scan Coverage %	Soil Sample Measurements (pCi/g)							
				Number of Samples	Co-60			Cs-137			Weighted Sum
Max	Mean	Std Dev	Max		Mean	Std Dev					
12C ₁ 2	Beach north of restricted area										
15(1)C ₁ 2	Northern wooded area west of restricted area										
15(2)C ₁ 2	Southern wooded area west of restricted area										
16C ₁ 2	Beach area west of restricted area										
19C ₁ 2	Area around new radwaste staging/shipping location										
19C ₁ 2	Area around new radwaste staging/shipping location										
21C ₁ 2											
23C ₁ 2											
DDC ₁ 2	Drainage Ditch										

Table 3-3. Class 3 Land Area Final Status Survey Results Summary – to be completed in Part B

Survey ID	Description	Survey Area (m ²)	Scan Coverage %	Soil Sample Measurements (pCi/g)							Weighted Sum
				Number of Samples	Co-60			Cs-137			
					Max	Mean	Std Dev	Max	Mean	Std Dev	
13C ₁ 3	Wooded land east of industrial area										
14C ₁ 3	Beach west of industrial area										
15(3)C ₁ 3	Northern portion of land adjacent to west beach remediation area										
15(4)C ₁ 3	Northern portion of land adjacent to west beach remediation area										
17C ₁ 3	Wooded area east if industrial area (adjacent to Soil Verification Area)										
18C ₁ 3	Wooded area west of industrial area										
59C ₁ 3	Land area south of US 31										

Table 3-4. Excavated Surface Supporting Survey Results Summary – *partial, to be completed in Part C*

Survey ID	Description	Survey Area (m ²)	Scan Coverage %	Soil Sample Measurements (pCi/g)							
				Number of Samples	Co-60			Cs-137			Weighted Sum Mean
					Max	Mean	Std Dev	Max	Mean	Std Dev	
11C _{Q1} 1	Solid Radwaste Vault excavation surface	228	100	20	0.1330	0.0248	0.0314	0.4320	0.0840	0.1142	0.0148
09C _{Q1} 1	Screenhouse excavation surface	1820	100	20	0.0912	0.0162	0.0264	1.0740	0.1317	0.2925	0.0161
TBC _{Q1} 1	Turbine Bldg East excavation surface	1776	100	18	0.0615	0.0106	0.0269	0.2399	0.0270	0.0590	0.0056
DCC _{Q1} 1	Discharge Canal excavated surface	1300	100	19	1.6100	0.6828	0.6543	2.8100	0.3028	0.4606	0.1516
TBC _{Q2} 1	Turbine Bldg West excavation surface including Solid Radwaste Vault excavation surface		100								
CC _{Q1} 1	Containment excavation surface		100								

Table 3-5. Relocated Soil Supporting Survey Results Summary – partial, to be completed in Part C

Survey ID	Description	Survey Area (m ²)	Scan Coverage %	Soil Sample Measurements (pCi/g)							Weighted Sum Mean
				Number of Samples	Max	Co-60 Mean	Std Dev	Max	Cs-137 Mean	Std Dev	
SWC _{x1} 1	Soil from slurry wall construction	1800	100	24	0.0250	0.0035	0.0091	0.4550	0.0468	0.0951	0.0050
SWC _{x2} 1	Soil from slurry wall construction	1800	100	24	0.0297	0.0091	0.0158	0.4100	0.0990	0.1111	0.0111
TBC _{x1} 1	Soil from Turbine Bldg foundation	3100	100	22	0.0900	0.0341	0.0240	0.1300	0.0768	0.0368	0.0171
TBC _{x2} 1	Soil from Turbine Bldg foundation	1080	100	18	0.1800	0.0342	0.0454	0.1100	0.0635	0.0247	0.0160
TBC _{x3} 1	Soil from Turbine Bldg foundation	1440	100	26	0.0022	0.0002	0.0016	0.0086	0.0024	0.0022	0.0003
TBC _{x4} 1	Soil from Turbine Bldg foundation	1935	100	21	0.0431	0.0108	0.0141	0.0570	0.0300	0.0169	0.0059
TBC _{x5} 1	Soil from Turbine Bldg foundation	1800	100	20	0.0832	0.0087	0.0387	0.1205	0.0659	0.0256	0.0082
02C _{x1} 1	Soil from retention pond construction	150	100	19	0.0254	0.0056	0.0098	0.1040	0.0542	0.0189	0.0063
08C _{x1} 1	Soil from Turbine Bldg subfloor demolition	368	100	20	0.2632	0.1397	0.0596	0.2618	0.1357	0.0561	0.0549
09C _{x1} 1	Soil from Screenhouse demolition	1610	100	18	0.0732	0.0192	0.0245	0.2501	0.0687	0.0802	0.0117
09C _{x2} 1	Soil from Screenhouse demolition	1120	100	18	0.0679	0.0193	0.0184	0.4309	0.1672	0.1386	0.0200
09C _{x3} 1	Soil from Screenhouse demolition	825	100	18	0.0500	0.0014	0.0156	0.0870	0.0279	0.0226	0.0028
09C _{x4} 1	Soil from Screenhouse demolition	1200	100	18	0.0247	0.0048	0.0157	0.0617	0.0163	0.0180	0.0029
09C _{x5} 1	Soil from Screenhouse demolition	840	100	18	0.0542	0.0100	0.0187	0.1146	0.0157	0.0283	0.0044
09C _{x6} 1	Soil from Screenhouse demolition	1200	100	18	0.0248	0.0029	0.0093	0.0580	0.0139	0.0216	0.0021
09C _{x7} 1	Soil from Screenhouse demolition	106	100	18	0.0607	0.0169	0.0190	0.1596	0.0270	0.0426	0.0075
11C _{x1} 1	Soil from Solid Radwaste Vault demolition		100	18	0.0590	0.0114	0.0174	0.0920	0.0344	0.0256	0.0064
12C _{x1} 1	Soil from temporary bldg construction		100	18	0.0500	0.0099	0.0151	0.5800	0.2867	0.1171	0.0271
19C _{x1} 1	Soil from storm drain modification		100	18	0.0337	0.0131	0.0105	0.2000	0.0919	0.0361	0.0118

Table 3-6. Groundwater Monitoring Data – partial, to be completed in Part C

[illegible]

Table 3-7. Summary of Data Investigation Results and Actions Taken

Survey Unit	Class	Identified Locations		Description	Actions Taken
		Scan	Soil Samples		

4.0 Final Status Survey Data Assessment

4.1. Data Verification and Validation

Data were reviewed to verify that Data Quality Objectives (DQOs) established in each of the survey designs were met. Where appropriate, graphical representations and statistical comparisons of the data were made to provide both qualitative and quantitative information about the survey data. An assessment was performed to verify the data supported the underlying assumptions necessary for statistical tests if applicable.

4.1.1. Data Quality Review

Final status survey and supporting survey data were reviewed to ensure that they were complete, fully documented, and technically acceptable. The review criteria for data acceptability included the following items:

- The minimum detectable concentration (MDC) for the instrumentation used for radiological measurement was below the DCGL value for all radionuclides of interest;
- The instrument calibration was current and traceable to NIST standards;
- The field instruments were source checked prior to and after each survey to verify satisfactory field data collection;
- The MDCs and assumptions used to develop them were appropriate for the instruments and techniques used to perform the survey;
- The survey methods used to collect data were proper for the types of radiation involved and for the media being surveyed;
- "Special methods" for data collection were properly applied for the survey unit under review, if applicable;
- The chain-of-custody was tracked from the point of sample collection to the point of obtaining results;
- The data set is comprised of qualified measurement results collected in accordance with the survey design which accurately reflect the radiological status of the facility; and
- The data were properly recorded.

If the data review criteria were not met, the discrepancy was evaluated and the decision to accept or reject the data was documented in accordance with approved site procedures. The BRP Corrective Action Program was used to document and resolve discrepancies as applicable.

4.1.2. Graphical Data Review

Survey data was graphed to identify patterns, relationships or possible anomalies that would not be evident using other methods of review. As a minimum a posting plot was used for each survey unit.

4.1.3. Statistical Comparisons

Values of the median, mean, standard deviation and maximum radioactivity levels for both Cs-137 and Co-60 were determined from gamma isotopic results for each survey unit. The weighted sum using the unity rule was also calculated for each survey unit to allow comparison to the $DCGL_W$. These values are summarized in Tables 3-1 through 3-5 for each survey unit and are detailed in the assessment section of each final status survey package (Appendix C).

4.2. Release Criteria Verification

An assessment was performed for each final status survey or supporting survey data set to ensure adequate basis to that the survey unit met the criteria for unrestricted release. This process is described below and is summarized for each survey unit in Table 4-1.

4.2.1. Condition #1 – Mean Test

This condition requires that the mean residual radioactivity was less than the $1.0 \times DCGL_W$. To determine if this condition was met, the mean of the final survey unit data set for each survey unit was compared to the $DCGL_W$ (applying the unity rule). In all cases the mean residual radioactivity was less than $0.05 \times$ the $DCGL_W$ for each survey unit. Therefore, each survey unit satisfied Condition #1.

4.2.2. Condition #2 – Elevated Measurement Comparison

The Elevated Measurement Comparison (EMC) test requires that individual measurement representing small areas of residual radioactivity exceeding the $DCGL_W$ did not exceed the $DCGL_{EMC}$. Since all measurements were less than the $DCGL_W$, an EMC was not required for any survey unit and Condition #2 was automatically satisfied for all survey units.

4.2.3. Condition #3 – Sign Test

This condition requires that where one or more soil sample measurements in a survey unit exceed the $DCGL_W$, the average residual radioactivity passes the Sign statistical test. Since all soil sample measurements were less than $DCGL_W$, the Sign statistical test was not applied to any survey unit data set and all survey units satisfied Condition #3.

4.3. Summary of Changes from Initial Assumptions on Residual Radioactivity

Data measurements collected during performance of Final Status Surveys and supporting surveys did not identify radioactivity levels that altered any of the initial assumptions contained in the BRP LTP regarding residual radioactivity at the site.

4.4. ALARA Evaluation

In accordance with the release criteria (Section 1.3 an evaluation is required to determine if it is ALARA to reduce the levels of residual radioactivity to below concentrations necessary to meet the DCGL_w. The License Termination Plan, Section 4.4 contains the ALARA evaluation for Big Rock Point. This evaluation previously determined that both the site specific DCGLs for Class 1 and Class 2 areas and the screening DCGLs for Class 3 areas are considered ALARA for the land areas to be release for unrestricted use.

DRAFT

DRAFT

Big Rock Point Restoration Project
Final Status Survey Report

Survey Unit	Class	Description	Release Criterion			Survey Unit Passed?
			Condition #1 Mean Test	Condition #2 EMC Test	Condition #3 Sign Test	

DRAFT

5.0 Final Status Survey Conclusions

Scan and volumetric measurement data collected during final status surveys confirmed that the classification for each of the survey units was accurate. Final Status Surveys and supporting surveys demonstrate licensed radioactive materials were removed from BRP property to the extent that any remaining residual radioactivity is below the radiological criteria for unrestricted use and that all remaining surface and associated subsurface land areas were evaluated against the criteria for unrestricted use. The final survey data presented in this report plan demonstrate compliance with 10 CFR 20.1402 and the site impacted and non-impacted land areas meet the criteria for unrestricted use.

The information contained in this submittal together with the information provided in prior submittals and subsequent supplemental phases is sufficient for the NRC to make a determination equivalent to 10 CFR 50.82(a)(11) regarding the lands to be released from the license. Once these lands are so released, it is understood that the NRC will not require any additional surveys or decontamination of these areas unless the NRC determines that the criteria of 10 CFR Part 20, Subpart E were not met and that residual activity remaining on the land could result in a significant threat to public health and safety.

6.0 References

DRAFT

Consumers Energy Count on Us

Big Rock Point Restoration Project Tel: 231 547 8416
10269 US 31 North Fax: 231 675 7548
Charlevoix, MI 49720 Pager: 231 317 0567
E-Mail: kepallagi@cmsenergy.com

Kenneth E. Pallagi

Manager

Radiation Protection & Environmental Services

A CMS Energy Company

Consumers Energy Count on Us

Big Rock Point Restoration Project Tel: 231 547 8171
10269 US 31 North Fax: 231 237 2594
Charlevoix, MI 49720 E-Mail: dwparish@cmsenergy.com

David Parish

Analyst

Radiation Protection & Environmental Services

A CMS Energy Company

Consumers Energy Count on Us

10269 US 31 N. Tel: 231 547 8389
Charlevoix, MI 49720 Fax: 231 237 2595
Pager: 231 317 0569
E-Mail: tmgoble@cmsenergy.com

Tracy A. Goble, P.E.

Environmental Services Superintendent

Big Rock Point Restoration Project

A CMS Energy Company